

AROUND THE CLOCK

THE EFFECT OF NIGHT SHIFTS ON YOUR HEALTH & SAFETY

>> BY TERRY NUGENT, BS, EMT-P

There's nothing better than going home after a long day and getting a good night's sleep. EMS personnel who regularly work the day shift have the luxury of doing so and staying in sync with the natural sleep patterns of their family and friends. But for those who work nights or rotating shifts, maintaining healthy sleep-wake cycles and balancing professional obligations and personal well-being can be a constant struggle.

Unlike other unusual and extreme conditions that EMTs and paramedics tackle as part of their profession, sleep deprivation is an obstacle that's typically difficult to recognize and overcome. But with the growing amount of evidence about the hazards of

sleep deprivation, it's an issue that can no longer be avoided. Research shows that sleep deprivation affects not only our health but also our ability to perform skills and operate equipment in a safe manner. It's clear that driving an emergency vehicle under sleep-deprived circumstances can have devastating consequences. It's time to take this issue seriously—for the safety of our patients and ourselves—and understand the causes and explore possible solutions.

SLEEP-WAKE DISRUPTIONS

To keep up with the demands of our global economy, we've become a 24-hour society. Stores are open 24 hours a day, and ATM machines allow people to do their banking at

night. With such conveniences, it's seemingly easy for shift workers to keep "on schedule" with daily tasks. But is it that easy to adjust our clocks from day work to night work and back again?

Our natural, biological sense of when to rest and when to be awake is called the circadian rhythm. From the beginning of time, humans have been trained into cycles of light and dark. As the sun sets, daylight gradually shifts to darkness, leading to a period of sleep for most animals. At sunrise, a similar change in reverse brings us back to activity.¹

Disruptions of the circadian rhythm can lead to sleep deprivation and fatigue. Sleep deprivation is the overall lack of sleep necessary to function. In addition to work sched-

ules, sleep deprivation can be caused by stress and sleep disorders. Humans must sleep; without it, we become fatigued and can't function well. More than being tired, fatigue is the state of exhaustion and loss of strength.

Logically, shift workers are more prone to sleep deprivation by the nature of their fluctuating work schedules. One resource on shift work shows that health-care workers top the list as the largest group of non-daytime workers; management positions are at the bottom.² EMS has always been a 24-hour operation, with shifts varying from eight to 24 hours or longer. However, with increases in the call volume at night and demands by agencies that workers operate at maximum budgetary efficiency, what

used to be an occasional "all-nighter" has now become the norm. With these increased demands comes the increase in sleep deprivation for EMS personnel.

Acute sleep deprivation occurs when an individual is restricted to just five hours of sleep nightly for weeks and builds up a cumulative sleep deficit. Their performance will eventually be as impaired as if they had been up all night. It will take two to three weeks of extra nightly sleep before they return to baseline performance. Chronic sleep deprivation occurs when the body slowly loses sleep that isn't recovered by the normal sleeping process. The impact of chronic sleep deprivation takes much longer to build up and much longer to recover from.¹

SAFETY & LEGAL ASPECTS

Our 24-hour society is here to stay, but so is our biological urge to sleep. Thus, corporations and industries pay a high price for their sleep-deprived workforces. Across all industries, reduced job alertness costs employers an estimated \$70 billion a year. According to the Association of Professional Sleep Societies, the fatigue of nighttime operators contributed to four well-known disasters: The Exxon Valdez accident occurred at 00:15, Bhopal at 01:00, Chernobyl at 01:23 and Three Mile Island at 04:00.^{3,4}

In addition, the 1986 Presidential Commission on the Space Shuttle Challenger Accident acknowledged that human error



PHOTO: ROBERT ROWLAND

EMS agencies are beginning to recognize maintenance naps as a method to avoid sleep deficits in their crews and reduce potential errors.

and poor judgment related to sleep loss and early morning shift work contributed to that accident.⁵ The same commission also attributed operator fatigue as a major reason for a potentially disastrous draining of liquid oxygen from the space shuttle Columbia just minutes before a scheduled launch. The operators involved were nearing the completion of their third 12-hour night shift.

Getting fewer than six hours of sleep during one sleep-wake cycle can affect coordination, judgment and reaction time.⁶ Beyond the historical examples of this effect, research has shown that the performance of a sleep-deprived worker is similar to that of an intoxicated person.⁷ In one study, people with 24 hours of sustained wakefulness performed tasks that involve tracking at a level comparable to those with 0.10% blood-alcohol content (BAC).⁸

Studies of simulated driving have had similar results.⁸ People who drove after being awake for 17–19 hours performed worse than those with a 0.05% BAC.⁹ Further, staying awake for 24 hours can have the same performance impairments as if you had a 0.096% BAC. In all 50 states, it's illegal to drive with a BAC of 0.08% or higher.¹⁰

The National Transportation Safety Board considers fatigue a key factor when conducting investigations of accidents. Although studies have not been conducted on EMS accidents, numerous studies have focused on airline pilots who also have the responsibility of safely transporting people. One report concludes that “if the sleep-wakefulness histories and circadian timing of crew members who have been involved in accidents suggests that fatigue was present, the board formally identifies fatigue as a contributing factor to the accident.”⁸

Research by the AAA Foundation for Traffic Safety points out risk factors implicated in drowsy-driving crashes. They include being awake for 24 hours or more; having six hours of sleep or less in the last 24 hours; driving between midnight and 6 a.m.; frequently feeling drowsy while driving; working a night shift; and working more than one job. Individuals with any one of these indicators are at a much higher risk of having a drowsy-driving crash, even if they don't feel tired.¹¹

The nature of driving itself can add to sleepiness while on duty. Many EMS transfers are from smaller hospitals to larger ones with a higher level of care, and those transports often occur on the night shift. Long-distance driving at night poses a greater risk for accidents or near-accidents due to fatigue than during the day shift. Further, monotonous conditions can induce sleep, particularly at certain times of the day and in association with sleep deprivation. Droning noises, such as tires on the road, the rhythm and hypnotic sounds of wind-

shield wipers, rain and even sirens may lull a driver into “microsleep.” A period of sleep lasting no more than a few seconds up to a minute, microsleep results from fatigue and sleep deprivation and is often unrecognized. People who experience it remain unaware of the event, instead believing they've been awake the whole time.⁹ Their partner may be the first to recognize it.

Due to the overwhelming consequences of driving while sleep deprived, the first federal bill focusing on drowsy driving was introduced in the House of Representatives in October 2002 by Rep. Robert Andrews, D-N.J. The bill, HR5543, is called “Maggie's Law: National Drowsy Driving Act of 2002.”¹² It was named after Maggie McDonnell, a 20-year-old college student from New Jersey who was killed by a drowsy driver on July 20, 1997.¹³ It stipulates that a sleep-deprived driver qualifies as a reckless driver who can be convicted of vehicular homicide.

Compounding the issue, employers may be found responsible if their exhausted workers fall asleep at the wheel after unreasonable working hours were required.⁵ In the sleep-related case *Faverty v. McDonald's Restaurants of Oregon Inc.*, the plaintiff claimed that a McDonald's restaurant knowingly allowed a visibly fatigued employee to drive home after working nearly 12 hours.¹⁴ The employee, a high school student who had asked to leave work because he was sleepy, subsequently caused a motor vehicle crash, resulting in his death and the critical injury of another driver.

The critically injured driver sued McDonald's for negligence, citing that it scheduled employees for too many hours of work without adequate time for rest. Although McDonald's argued that the employee volunteered to work extra shifts, the court concluded that the employer should have foreseen that an employee who worked three shifts in a 24-hour period would pose a risk of harm to themselves and other motorists. The court stated that the management's liability was similar to that of a bartender who serves a visibly intoxicated person who “volunteers” to pay for the drink and later causes an accident.¹⁴

Driving while sleep deprived doesn't stop when we clock out. In fact, affected staff could be at greater risk for erratic and dangerous driving when *leaving* work after a night shift. Many employees would admit to past instances of running a red light, finding themselves somewhere other than their home, or finding their way home and having no specific recollection of driving there.

As shown by history and research, sleepiness/fatigue in the workplace leads to poor concentration, absenteeism, accidents, errors, injuries and even fatalities. The issue becomes more alarming when you consider that shift workers are often employed in the most dangerous of jobs, such as EMS, firefighting, law enforcement and security. In EMS, peak attention to detail, sound judgment and quick reaction time are necessary in order to respond in a safe and expeditious manner, as well as to provide exceptional patient care and safe transport to the hospital. Multi-tasking is also integral and requires cognitive thinking—which a tired brain won't allow to happen as quickly. Managers and policy makers must address the issues of a 24-hour workforce up front, which requires an investment in training and other measures.

Specifically, driver-fatigue litigation is on the rise, and it's vital that management examines the consequences of drowsy driving and becomes proactive in managing this potential problem. Employers must educate their employees on the danger of drowsy driving, control long work hours and develop policies that minimize this new legal liability.¹⁵ Ignoring the needs of the shift worker is reckless and irresponsible.¹²

HEALTH EFFECTS

In addition to compromised production and safety, health problems related to sleep deprivation are beginning to emerge at an alarming rate. By 1978, concerns about the effects of shift work led the National Institute of Occupational Safety and Health (NIOSH) to

issue a warning that shift work and rotating shifts posed a significant health risk to workers.¹⁶ An article in the Tufts University Health and Nutrition Letter identifies health problems related to sleep deprivation, including tired heart, diabetes, immunity, obesity, depression and irritability.^{17,18}

Additionally, the common perception that we're more susceptible to infections and illnesses when deprived of sleep is supported by recent research that concludes sleep should be a vital part of the health of the immune system.¹⁹ A growing body of evidence, as reported by the National Sleep Foundation, also indi-

cates that even minor sleep loss, particularly if it accumulates over long periods of time, has notable behavior and cognition consequences.

One major health problem is shift-work sleep disorder (SWSD), a condition seen in people who work at night or on rotating shifts who have a misalignment of the circadian rhythm

due to sleep disruption. The disorder is characterized by excessive sleepiness during night work and insomnia when attempting to sleep during the day.²⁰ Unlike other disorders, SWSD may often be reversed or prevented when recognized. However, if it's not recognized and addressed, it can be debilitating and

dangerous, with sleep deprivation remaining the underlying cause.

Researchers have hit only the tip of the iceberg regarding sleep deprivation and the general well-being and balance of the body's systems. According to Charles Czeisler, MD, PhD: "The sleep-deprived metabolic syndrome ►

A RUDE AWAKENING >> By Terry Nugent, BS, EMT-P

My first patient of the day was a sweet, elderly woman who was fighting a 24-hour bout of vomiting and diarrhea. She was weak and dehydrated, and needed evaluation and fluid replacement. While preparing to start the IV, the IV catheter stuck on my glove and flipped backward, sticking the top of one of my fingers. I checked my finger and saw a small pinhead-size spot of blood under my glove. I didn't think much of it, changed my gloves and continued starting the IV. Three days after the stick, the end of my finger was abscessed and swollen to the size of a grape.

Since that needlestick, I've been on one antibiotic or another for various infections, including sinusitis, tonsillitis, a boil, what looked spider bites on my arm, and small nicks that became infected. In the past year, I averaged an infection every six to eight weeks. I asked our agency physician if he would culture me for MRSA. He believed I was too young to have it, but ordered the culture. A couple of days later, the results confirmed I had MRSA.

This latest incident was my rude awaking. I needed answers. The past 18

months had been filled with more than just recurring infections. My problem started with overwhelming exhaustion. I was no different than any other EMS provider: I burned the candle at both ends but didn't feel I had any problem with working a 24-hour shift and then going home and doing housework, yard work, school work, taking care of family obligations and traveling to visit family members scattered over three time zones.

But typically at the end of my first day off (we worked 24 on and 48 off), I was so exhausted that my ears were ringing and I prayed that I would make it to my bed. I woke up tired on my second day off and felt the same way. On the third day, I reported to work for another 24-hour shift. Having this routine for a number of years took its toll, and I started to lose ground. My sleep deficit was so great that I could no longer handle 24-hour shifts. I began to use my vacation time for the second half of my shift and go home to sleep. It was during this time that my infections started. I had chronic sinusitis and was running a low-grade fever in between antibiotic regimens.

The needlestick was actually a blessing in a dark sort of way. I was prescribed Vancomycin and was reassured by my doctor that MRSA is quite common and dormant in those with a healthy immune system. He referred me to an infectious disease specialist, who luckily saw through my symptoms and targeted the underlying problem. She tested my immune system, in particular the quantitative immunoglobulin (antibodies), and found a decreased IgG level of just above 600—when my immune system should have been producing a high number of antibodies to fight off infection. (Normal values in a healthy person are 640–1,430.)

She also suspected I had allergies and referred me to an allergist/immunologist, who played an active part in my recovery by helping me understand allergies, the immune system and the need for sleep. The allergies I tested positive for weren't serious, but they did cause sinusitis and tonsillitis, which always resulted in infections and the need for antibiotics. I started to understand the vicious cycle I was in. Sleep deprivation didn't allow my immune system any downtime to repair and rejuvenate. Chronic sleep deprivation left my immune system "running on empty" at times when it was supposed

to fight off everyday exposures that a healthy system takes in stride.

The answer was easier than I expected. I was told to sleep more and was prescribed an antihistamine. During this time, my service went to 12-hour shifts, which allowed me to go home and actually sleep with both eyes closed.

It took about a year for me to get back to a truly functional level. I was fortunate to have a patient and supportive management staff. I took intermittent FMLA leave for about a year, and slowly got to the point that the time between rounds of antibiotics became longer and longer.

I still frequently run a low-grade fever, especially in the height of allergy season; it's how my immune system responds. If I skip one day of the antihistamine, I start to feel the effects—and start sliding back. Similarly, if I go without sleep, my temperature goes up, and I'm quickly reminded how important it is to rest and recuperate.

Your immune system is a major part of your body and plays such an important part in protecting and regulating your other systems. For all that it does for you, it only asks for one thing in return: Allow it time to rest. Take heed and get off the dangerous road to sleep deprivation.

might increase carbohydrate cravings and the craving for junk food. [When] restricted to four hours [of sleep] a night, within a couple of weeks, you could make an 18-year-old like a 60-year-old in terms of their ability to metabolize glucose.”¹

Because we, as a society, are beginning to show breakdowns of bodily systems, sleep and health experts are emphasizing that sleep deprivation must be taken seriously. “You can make up for acute sleep deprivation,” says David P. White, MD, a professor of sleep medicine and director of the Sleep Disorders

Program at Brigham and Women’s Hospital in Boston. “But we don’t know what happens when people are chronically sleep-deprived over years.”¹

SOLUTIONS

Organizations that have night shifts are seeing a rise in employee turnover, absenteeism, chronic illnesses, and on-the-job injuries and accidents. To combat these problems, organizations must proactively address the root cause with education and perhaps additional methods.

One solution is smarter scheduling. Because EMS agencies must continually staff and maintain a certain number of ambulances, absent employees are often replaced from a pool of per diem workers. Many of these per diem employees work other jobs, usually with other ambulance services, and are often asked to fill night-shift positions. If they’re filling a vacation spot, managers should schedule them as far in advance as possible to allow them to adjust their schedules to sleep before coming on duty. It’s dangerous to have a per diem employee work a shift if they haven’t had any sleep prior to the beginning of the shift.

Another solution is drug therapy. In the first clinical trial of SWSD, researchers at the Brigham and Women’s Hospital evaluated the use of modafinil (Provigil), a drug used for narcolepsy. They found that the drug improved nighttime sleep latency and clinical symptoms, but excessive sleepiness still remained. They concluded that additional research was still necessary.²⁰

An over-the-counter drug that’s becoming more popular for sleep regulation is melatonin. In humans, melatonin is naturally produced by the pineal gland in the center of the brain and also naturally contained in some foods. Human production depends on exposures to light and darkness, peaking in the middle of the night. Although it hasn’t been approved by the FDA, some believe the use of melatonin as a dietary supplement can help reset the circadian rhythm and allow users to fall asleep faster or stay asleep longer.¹²

Related to melatonin use is light therapy, which is also gaining acceptance as a treatment for circadian disruptions associated with shift work. Light therapy consists of exposure to specific wavelengths of lights using lasers, LEDS, fluorescent lamps, dichroic lamps or very bright full-spectrum light for a prescribed amount of time. It has proven effective in treating acne, seasonal affective disorder (SAD), non-seasonal depression, and for some people has improved delayed sleep phase syndrome.⁹

The lack of sunlight in the night-shift environment has known health effects. SAD is a mood disorder that occurs when certain people don’t get the required amount of sunlight due to shorter days in the fall and winter months. Night-shift work not only aggravates this condition, but it can possibly contribute to depression by having the same effects as SAD due to decreased exposure to sunlight. According to Charmane Eastman,

PhD, director of the Biological Rhythms Research Laboratory at Rush-Presbyterian—St. Luke’s Medical Center in Chicago, bright light improves sleep and alertness in night-shift workers, facilitating their adaptation to a new schedule.²¹

Lights may be used at home to prepare for a shift change and in the workplace. Additionally, Eastman’s research shows that night-shift workers benefit from protecting themselves from exposure to conflicting cues from sunlight by wearing dark sunglasses on their way home from work in the morning. Night-shift workers should also sleep at consistent times after the shift and light-proof their bedrooms for day sleep.²¹

One of the most successful solutions is the Strategic Maintenance Nap (SMN) program. Maintenance naps are defined as naps that occur on the job, during the shift. James B. Maas, PhD, a psychologist and sleep expert at Cornell University, says, “Napping should not be frowned upon at the office, or make you feel guilty at home. It should have the same status of daily exercise.”¹⁹ Therefore, corporations and many organizations are tossing aside the notion that napping on the job shows a lack of professionalism or poor management in favor of its positive effects on employee health.

Two devices are also now on the market that address driver fatigue and fatigue-related accidents. The EyeAlert Driver Fatigue Monitor measures the eye closure of the driver, known as PERCLOS (which stands for percent eye closure). PERCLOS is the only measure of driver fatigue that has been scientifically validated by NHTSA. The fatigue monitor is a compact video-focused sensor that measures slow eyelid closure (PERCLOS) associated with drowsiness. The portable monitor can be mounted on the dashboard to assess how long it takes for the driver’s eyelids to close. When drivers become drowsy and have slowed eyelid closure, it sounds an alarm.

SafeTRAC by AssistWare, another device used to alert vehicle operators to drowsy driving, is a vision-based lane tracking system. The unit consists of a small camera mounted on the windshield and a driver-interface box that can be mounted on the dash. The drowsy-driver function tracks a driver’s lane centering in rolling eight- to 10-minute periods and constantly displays a numeric performance score. If the alertness score drops below an established number, a warning tone is generated.²²

These monitors are useful and have been shown effective. Modafinil, melatonin, driver-alertness monitors and lane tracking are meant to combat the fatigue associated with sleep deprivation. However, the underlying problem still exists—lack of proper sleep associated with a fractured circadian rhythm. Educating and helping shift workers understand why they feel the way they do and implementing solutions to synchronize rest, sleep and proper timing coinciding with the circadian rhythm will help personnel be more alert and get their required sleep when they’re off duty.

CONCLUSION

Because research on sleep deprivation is still in its early stages and EMS has not been specifically studied, it’s still unknown to what degree it affects prehospital providers. But it’s clear that people who work multiple jobs, extended or rotating shifts, and night shifts are at an extremely high risk for sleep deprivation. Addressing this problem through sleep-health awareness and education will help lessen such problems as drowsiness and fatigue, chronic illnesses, on-the-job injuries, absenteeism and scheduling per diem. Attention to

these areas could save money, reduce liability, increase efficiency, and prevent injuries and deaths. [JEMS](#)

Terry Nugent, BS, EMT-P, is a paramedic field supervisor for Medical Center EMS in Bowling Green, Ky., where she's a member of a research team for the "OZ" project, studying shift configuration, ALS/BLS split, recruitment and retention, and the health and safety of EMS employees. Contact her at tln1536@yahoo.com.

REFERENCES

1. Lambert C: "Deep into sleep." *Harvard Magazine*. July/August:25–26, 2005. www.harvardmagazine.com.
2. UE Steward-United Electrical, Radio, and Machine Workers of America: "Fatigue and shift work." www.ranknfile-ue.org/stwd_fatigueshift.html.
3. Injuryboard: "Fatigue, sleepiness and medical errors." www.injuryboard.com/view.cfm/Article=822.
4. Dohoney SW: "Sleep logistics as a force multiplier: An analysis of reported fatigue factors from Southwest Asia warfighters." *Storming Media*. www.stormingmedia.us.
5. Scott, AJ: "Chronobiological considerations in shiftworker sleep and performance and shiftwork scheduling." *Human Performance*. 7(33):207–233, 1994.
6. The Private Clinic: "Sleepy drivers just as dangerous as intoxicated drivers." www.theprivateclinic.co.uk/newspapers_articles/snoring/article14.htm.
7. Czeisler C, Brainard GC: "NSBRI human performance factors, sleep and chronobiology team strategic plan." National Space Biomedical Research Institute. <http://nsbri.tamu.edu/Research/StrategicPlans/Sleep2003.pdf>.
8. Gaba DM, Howard SK: "Patient safety: Fatigue among clinicians and the safety of patients." *New England Journal of Medicine*. 347(16):1249–1255, 2002.
9. Williamson AM, Feyer AM: "Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication." *Occupational and Environmental Medicine*. 57(10):649–655, 2000.
10. dmv.org: "DUI & DWI." www.dmv.org/automotive-law/dui.php.
11. Naval Safety Center: "Work zone: Drowsy driving." www.safetycenter.navy.mil/MEDIA/seashore/issues/fall04/drowsydriving.htm.
12. National Sleep Foundation. www.sleepfoundation.org.
13. Warner J, Smith M: "Driving drowsy could land you in jail." WebMD. www.webmd.com/content/Article/74/89360.htm.
14. Gefell AW: "Dying to sleep: Using federal legislation and tort law to cure the effects of fatigue on medical residency programs." *Journal of Law and Policy*. 11(2):645–686, 2002. www.brooklaw.edu/students/journals/bjlp/jlp11ii_gefell.pdf.
15. Insurance Journal: "Maggie's law underscoring the importance of corporate fatigue management." www.insurancejournal.com/news/national/2003/08/12/31404.htm.
16. Swenson DX: "Into the night: Coping with the effects of shift work." *Modernizing of shift work, Police Scheduling and Resource Allocation*. 1999. <http://faculty.css.edu/dswenson/web/shiftwork/Shift1.htm>.
17. "And to all a good night: How sleep deprivation may lead to chronic disease." *Tufts University Health and Nutrition Letter*. 22(8):8–11, 2004.
18. Rivera H, Villepigue J: "The maladies of sleep deprivation." Dolfzine Online Fitness. www.dolfzine.com.
19. Brody JE: "Science Times: New respect for the nap, a pause that refreshes." *The New York Times*. Jan. 4, 2000. pp. D.
20. eMaxHealth: "Medication helps reduce extreme sleepiness among sufferers of shift-work sleep disorder." www.emaxhealth.com/cms/?m=show&opt=printable&id=5154.
21. Lamberg L: "Medical news and perspectives: Dawn's early light to twilight's last gleaming." *JAMA*. 280(18):1556–1558, 1998.
22. Barton T: "Technology vs. fatigue." *NATSO Trucker News*. July 2003. www.etrucker.com/apps/news/article.asp?id=39788.